



METHODOLOGY FOR THE CALCULATION OF THE GREENHOUSE GAS EMISSIONS (GHG) INVENTORY.

1. Scope of the inventory

Organisational boundaries

The calculation of the emissions of Red Eléctrica de España, SAU (hereinafter REE) is performed under the criteria of operational control. The inventory solely applies to activities in Spain.

Operational boundaries

Emissions associated with the activities and facilities of REE are quantified taking into consideration the following scopes:

Scope 1: Direct Greenhouse gas emissions (GHG)

Those that occur from sources controlled or owned by the Company:

- Stationary combustion: from the combustion of fuels used in diesel generators sets (No other stationary combustion source exists in the Company)
- Mobile Combustion: from fuel consumption by fleet vehicles
- Fugitive Emissions: SF6 gas leaks
- Fugitive Emissions: leaks from air conditioning gases

Scope 2: Indirect GHG emissions from electricity consumption.

- Electricity consumption
- Electricity losses in the transmission grid



Scope 3: Other indirect GHG emissions

- Emissions associated with purchased goods and services (supply chain)
- Emissions from downstream transportation and distribution (internal logistics, subcontracted to an external company)
- Emissions associated with business travel
- Emissions from employees commuting to the workplace

2. Calculation methods

2.1 Direct emissions: SCOPE 1

2.1.1 Emissions from fuel consumption for diesel generators sets

In many of REE's substations and some buildings (work centres) there are diesel generators sets available in order to guarantee the power supply in case of a power outage. Generally (with exceptions) operating hours correspond to start-ups necessary for the proper maintenance of the generating sets.

- Calculation method:

This is calculated based on the running hours and the power of the generator sets (Apparent power).

Apparent power (KVA) * power factor (0.8) = Electric power (kw)
Electric power*working hours = energy generated (kWh)

Assumptions made: Power factor assumed = 0.8. We also assume that the groups are operating at full power (this means considered the worst option for emissions)

Emission factor used: 0.2628 kg CO2/kWh (Source: factor published by GENCAT)



2.1.2 Emissions associated with fuel consumption of fleet vehicles

Only vehicles owned by REE are considered fleet vehicles. Vehicles used by directors are not included (renting shared regime).

- Calculation method:

The calculation is performed using the following formula: Total litres of fuel consumed (per type) x emission factor (according to type)

Emission factor: based on the indications “GHG Protocol: Cross sector service office”:

Gasoline (kg CO₂/l): 2.34

Diesel (kg CO₂/l): 2.68

2.1.3 SF6 Emissions

SF6 gas is a dielectric gas used in electricity substations. It is mainly found in switchgear and Gas Insulated Substations (GIS).

- Calculation method:

The calculation is performed using the following formula:

Total SF6 leaks = leaks from the operating equipment + Leaks from accidents.

Leaks from operating equipment = amount of SF6 installed x emission factor

Emission factor: This uses the factors adopted for SF6 emission calculations performed under the framework of the Voluntary Agreement between the Ministry of Environment, the Spanish National Association of Manufacturers of Capital Goods (SERCOBE), the Spanish Electricity Industry Association (UNESA) and REE to limit the emissions of sulphur hexafluoride, signed in March 2008.



| Emission factor according to equipment manufacturing year | |
|---|-------|
| 1990-1998 | 2% |
| 1999-2007 | 1% |
| From 2008 | 0.05% |

CO₂ emissions: to convert from SF₆ emissions to CO₂, the GWP value of 22800 over 100 years, published in the 2007 IPCC fourth assessment report, is used.

2.1.4 Fugitive emissions associated with the use of air conditioning

Air conditioning units are located both in buildings and substations.

- Calculation method:

The calculation is performed based on the gas refills made during the year (gas refilled = gas leaked).

Refills per type of refrigerant gas x GWP.

GWP over 100 years published in the 2007 IPCC Fourth Assessment Report shall be used, included in SACE Tool (Andalusian Emissions Offset System Tool). When GWP is not included in this tool, the manufacturer's data sheet GWP value is used.

2.2 Indirect emissions. SCOPE 2

2.2.1 Emissions associated with electricity use

These are emissions associated with electricity consumption in the different facilities. Emissions associated with transmission grid losses are not included.

- Calculation method:

It is calculated by multiplying the electricity consumption by the average emission factor of the Spanish energy system in the year for which the inventory is being drafted.



Emission factor: calculated by REE according to the methodology developed by the Department of Demand Management of REE. The Spanish peninsular emission factor is considered for all cases.

2.2.2 Emissions associated with transmission grid losses

The transmission of electricity inevitably involves grid losses in such a way that in order to satisfy a determined final consumption it is necessary to have a somewhat higher generation. There are various reasons and factors contributing to these losses with the Joule Effect being the most important of them.

The amount of losses that occur is related to the location of the generation points relative to those of consumption, the amount of energy demanded in the year, the generation mix, the international exchanges and the shape of the demand curve(*).

To calculate the emissions, only those transmission losses related to the Spanish peninsular electricity system are considered.

- Calculation method:

Transmission grid losses x average peninsular emission factor for the year for which the inventory is calculated.

Transmission grid losses: Those published in the daily electricity balance for 31 December of the year to be calculated.

<http://www.ree.es/en/balance-diario/peninsula/2014/12/31>

Emission factor: the factor calculated by REE is considered, as in section 2.2.1.

2.3 Indirect emissions. SCOPE 3.

2.3.1 Emissions from purchased goods and services

These correspond to the emissions associated with goods and services purchased by REE.



- Calculation method:

An estimated calculation is performed based on the emission factors (t CO₂ / Euro) for each supplier, which are multiplied by the volume of spending by each supplier for the corresponding year.

Emission factors: For relevant suppliers emission factors are calculated according to direct data supplied by them through on line portal. For other suppliers, factors are estimated according to an input-output model.

2.3.2 Emissions associated with business travel

Emissions associated with business travel via air, rail (high-speed train and long distance train) and car (privet or rented) are contemplated.

2.3.2.1 Air travel

The methodology of the International Civil Aviation Organisation is used for the case of air travel.

http://www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology%20ICAO%20Carbon%20Calculator_v8-2015.pdf

Tool:

<http://www.icao.int/environmental-protection/CarbonOffset/Pages/default.aspx>

2.3.2.2 Rail travel

For rail travel, the emission factors per km provided by RENFE's 2007 Environmental Report (Spanish National Railway Network) are applied.

| Emission factor: kg CO ₂ /km and passenger | |
|---|---------------|
| High Speed Train | Long distance |
| 0.0211 | 0.02624 |



2.3.2.3 Car travel

In order to get the amount of emissions from car travel, SACE's tool (Andalusian Emissions Offset System Tool), which requires the distance travelled by this type of transport method, is used.

2.3.3 Emissions associated with downstream transportation and distribution (internal transportation of materials, logistics)

These are the emissions associated with the transportation of materials between the various facilities of REE. These transportations are carried out by an external contracted firm.

- Calculation method:

The calculation of emissions is based on the litres of diesel consumed by the logistics firm vehicles to carry out REE's activities. The emission factor used for the calculation is the same as the factor used for fleet vehicle.

2.3.4 Emissions associated with employees commuting

Data from the employees is obtained through an annual survey. This survey provides information regarding the distance (km) travelled and means of transport used by the employees.

- Calculation method:

The calculation is made using the previously mentioned tool of SACE (the Andalusian Emissions Offset System).

3. Process

The environmental department receives data from different REE units and uses this information to calculate the emissions accordingly.



Once the GHG Inventory is calculated, it is revised by the REE Environmental team and at the end, reviewed by an external verification organisation.